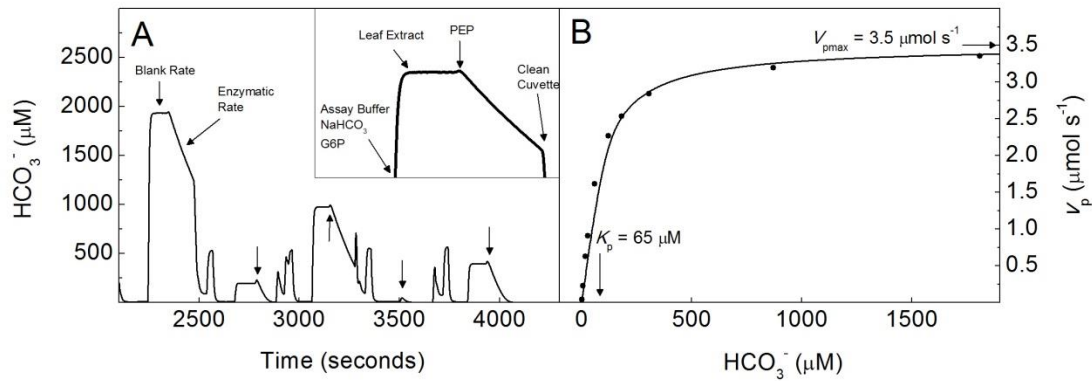
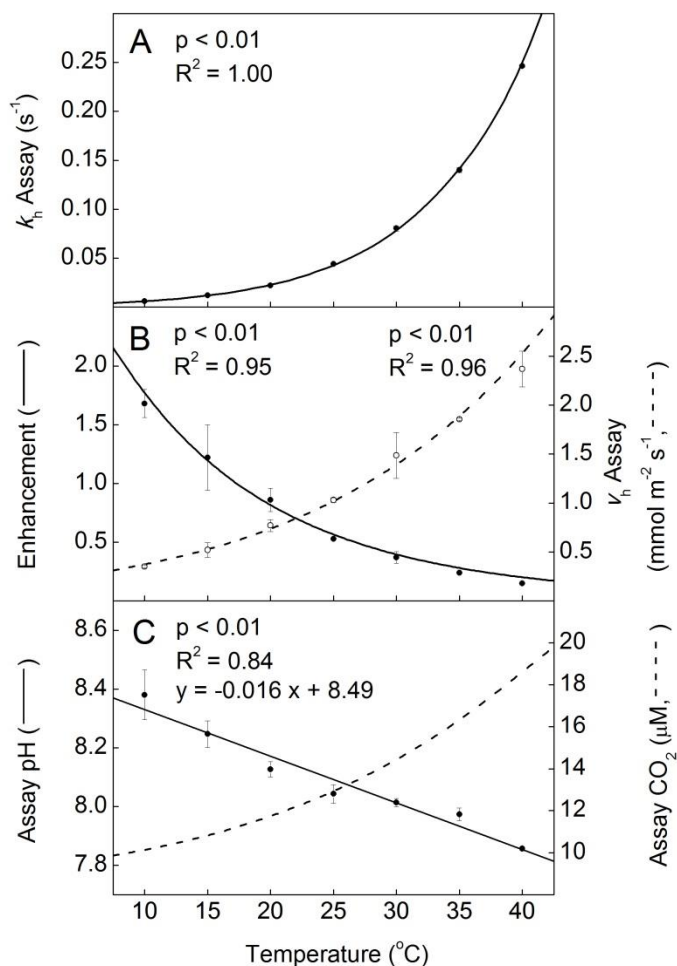


Supplemental Figure 1. The temperature response of Rubisco carboxylation (v_c) and oxygenation (v_o) modeled at $p\text{CO}_2$ and $p\text{O}_2$ expected at the site of Rubisco carboxylation in a C_3 species (25 Pa CO_2 and 21 kPa O_2 ; Panel A and B), and a C_4 species (400 Pa CO_2 and 35 kPa O_2 ; Panel C and D). The solid black lines are the modeled temperature response of *S. viridis* from this report. Dashed and dotted lines are temperature responses from previous reports assuming a k_{catCO_2} of $3.3 \text{ mol CO}_2 \text{ mol}^{-1} \text{ site s}^{-1}$ (Badger and Collatz, 1978; Jordan and Ogren, 1984; Bernacchi et al., 2001 and 2002; Walker et al., 2013).



Supplemental Figure 2. An example measurement of PEPc activity on the membrane inlet mass spectrometer at 25 °C. Panel A shows the plot of HCO_3^- concentration during the assay with the blank and enzymatic rate of HCO_3^- consumption identified in the first assay point and subsequent arrows identify the points just after the blank and before the catalyzed rates. The expanded section in panel A shows one representative HCO_3^- concentration and the injections of assay buffer (with NaHCO_3 and glucose 6-phosphate) followed by the leaf extract and initiation of the reaction with PEP. The noise between assays is due to cleaning of the cuvette. The data from panel A are plotted as the Michaelis-Menten response of PEP carboxylation (v_p) versus $[\text{HCO}_3^-]$ with the maximum rate of PEPc (V_{pmax}) and the Michaelis-Menten constant for HCO_3^- (K_p) labeled.



Supplemental Figure 3. The temperature response of the uncatalyzed and carbonic anhydrase catalyzed hydration of CO₂ measured with membrane inlet mass spectrometry. The 1st order uncatalyzed rate constant for the hydration of CO₂ under the assay conditions ($k_{h \text{ assay}}$) was calculated in response to temperature (panel A). The enhancement over the uncatalyzed rate of CO₂ hydration with the addition of leaf extract (solid line, panel B) was used to calculate carbonic anhydrase CO₂ hydration activity (v_h) in response to temperature (dashed line, panel B). The calculated v_h took into account changes in pH (solid line) of the assay buffer and [CO₂] (dashed line) with temperature (panel C). The estimated change in CO₂ molarity used a pKa assuming 0.1 M ionic strength and the temperature dependency as described by Harned and Bonner (1945). The circles represent average values of three replicates with \pm SE. The p-value refers to the significance of the temperature response from zero and the adjusted R^2 value describes the amount of variation in the measured parameter explained by the model. The lines represent the modeled fits of the measured data using the equation $\text{parameter} = k_{25} \exp\left[\frac{E_a (T_k - 298.15)}{(298.15RT_k)}\right]$ for k_h , enhancement, and v_h , and $y = mx + b$ for pH. The k_{25} and E_a were 0.0428 s⁻¹ and 91.3 kJ mol⁻¹ for k_h , 0.512 and -59.3 kJ mol⁻¹ for enhancement, and 1004.327 mmol m⁻² s⁻¹ and 47.2 kJ mol⁻¹ for v_h . For pH, $b = 8.49$, and $m = -0.016$.